CHEM-BIO DEFENSE

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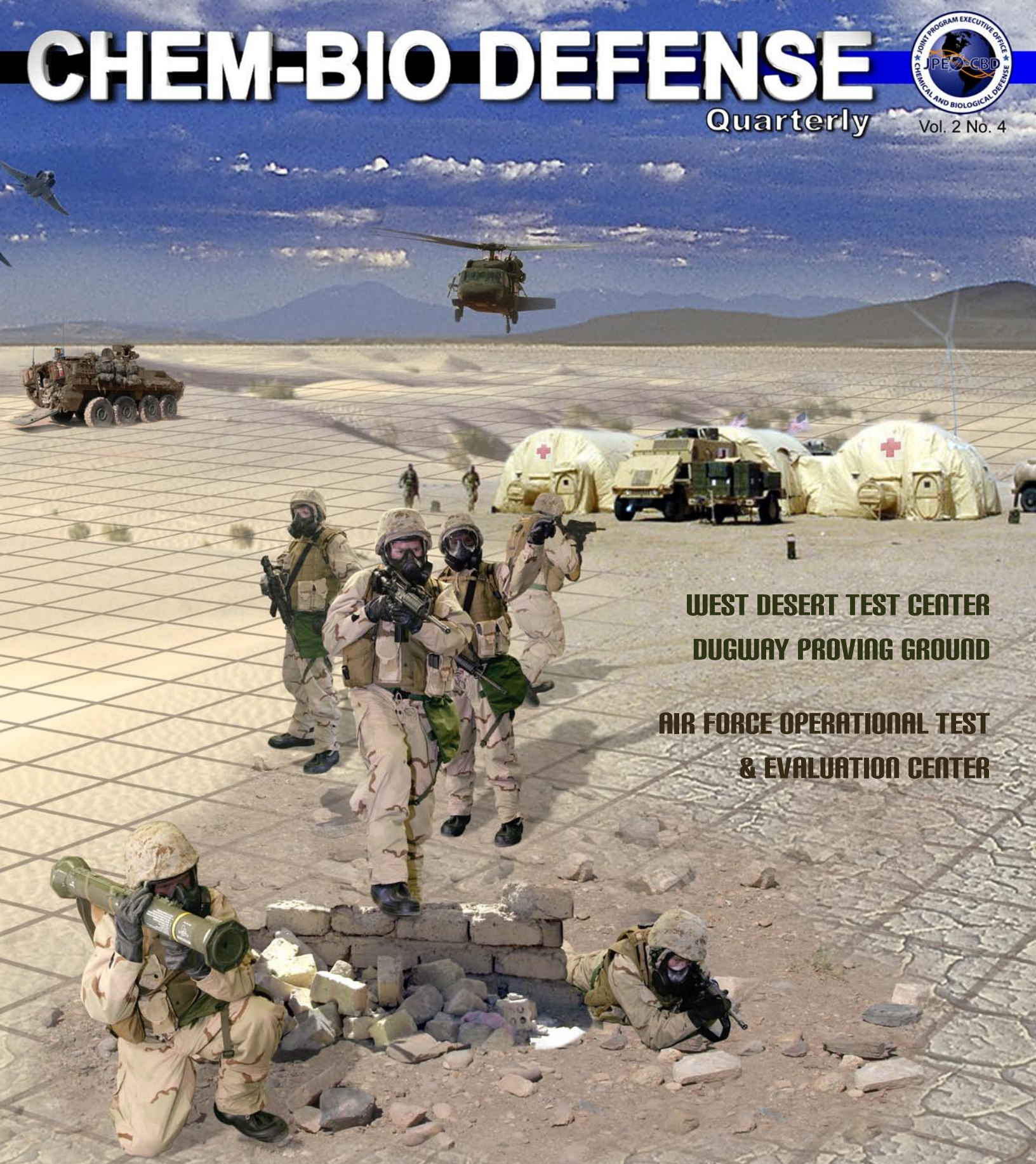
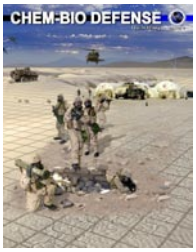


WEST DESERT TEST CENTER
DUGWAY PROVING GROUND

AIR FORCE OPERATIONAL TEST
& EVALUATION CENTER

JPEO-CBD PROJECT SELECTED THE U.S. ARMY JOINT PROJECT MANAGER OF THE YEAR



Cover photo by:
Steven Lusher, Camber Corporation, showing Mr. Ryan Zimmerman in the Joint Service General Purpose Mask and the Joint Lightweight Suit Technology.

Back cover photo by: Larry Wakefield. Project Manager of the Year presentation. From Left to Right, Lt. Gen. Joseph L. Yakovac Jr., Military Deputy to the Assistant Secretary of the Army for Acquisition, Logistics & Technology, Col. Camille M. Nichols, Joint Project Manager Guardian and the Honorable Claude M. Bolton, Jr., Assistant Secretary of the Army for Acquisition, Logistics & Technology.

The Joint Program Executive Office for Chemical and Biological Defense is the Joint Services single focal point for research, development, acquisition, fielding and life-cycle support of chemical and biological defense equipment and medical countermeasures.

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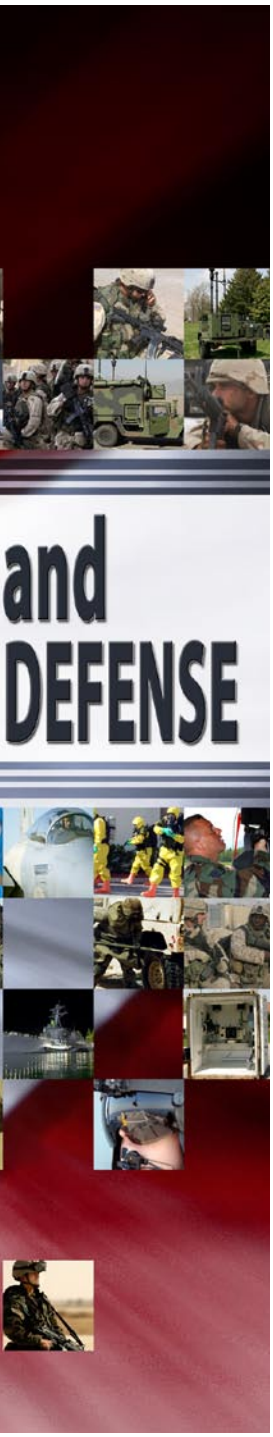

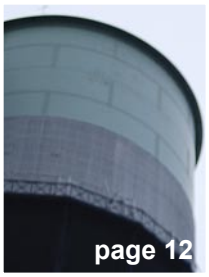

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From the Joint Program Executive Officer

Brigadier General Stephen V. Reeves
Joint Program Executive Officer
for Chemical and Biological Defense

"Houston, we have a problem." The now famous words of Navy Captain Jim Lovell began the saga of Apollo 13, the third US space mission intended to land on the moon. Exposed fan wires shorted and the Teflon insulation caught fire in a pure oxygen environment causing an oxygen tank explosion. The result was significant damage to the spacecraft, including losing all oxygen stores within about three hours, along with loss of water, electrical power and the propulsion system.

The cause of the fire was eventually traced to the failure to upgrade the heater thermostatic switches. An upgrade that should have occurred two years before the crew ever flew the mission.

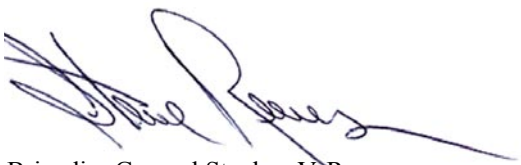
Our warfighters face hazards every day, whether on mission, in training, or in their daily lives. Their equipment shouldn't contribute to those hazards. Safety in our personal actions as well as in equipment design and operations is, as the Army Chief of Staff calls it, "a force multiplier."

One of the final stages before warfighters receive chemical and biological defense equipment is ensuring that equipment is safe and effective in an operational environment.

In this issue we visit the West Desert Test Center at the U.S. Army Dugway Proving Grounds in Utah and the U.S. Air Force Operational Test and Evaluation Center at Kirkland Air Force Base, New Mexico. These are two of the organizations that help independently assure the Joint Project Manager that equipment is safe and effective before fielding.

We also discuss avoiding hazards altogether. Identifying contaminated areas on the battlefield is a challenging and demanding mission. Once identified, ensuring the area is properly and visibly marked can be equally demanding. Through the efforts of the joint services at the U.S. Army Chemical School and the Joint Project Manager Contamination Avoidance, substantially improved contamination marking systems were evaluated, developed, and will soon be fielded.

Finally, congratulations to Col. Camille Nichols and the Joint Project Manager Guardian team for their selection as the Army's PM of the Year! Col. Nichols and her team were recognized in October at a formal awards dinner by the Honorable Claude M. Bolton, Jr., the Army's Acquisition Executive. Well done team!



Brigadier General Stephen V. Reeves
Joint Program Executive Officer
for Chemical and Biological Defense

Joint Program Executive Office

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DUCT TESTING

By Al Vogel, West Desert Test Center at US Army Dugway Proving Ground, Utah

The idea of terrorists introducing a biological warfare agent such as anthrax into a ventilation system was once the stuff of science fiction or suspense novels. Not anymore.

In today's world, with the U.S. and its allies at war against terrorists worldwide, the scenario has leapt off the page or screen and become a frightening concern.

If a biological agent were introduced into a heating, ventilation or air conditioning (HVAC) duct, how quickly would it travel? What percentage of the spores would be transported? Will the spores settle in the HVAC ducts? If they do settle, when the system is turned on will the spores become airborne again (resuspend)?

Scientists in Lawrence Livermore National Laboratory (LLNL) in California designed a series of tests to answer these questions, then went to the nation's premiere chemical & biological defense testing facility: the West Desert Test Center at U.S. Army Dugway Proving Ground (DPG).

A remote Army post in the desert of northwestern Utah, DPG has been the site of chemical biological defense testing since 1942. Dugway Proving Ground is under the command of U.S. Army Developmental Test Command, which in turn is under Army Test & Evaluation Command.

It was a natural location for the test by LLNL, since West Desert Test Center at DPG has the facilities and expertise for biological defense testing.

"The facility and technical expertise found at Dugway Proving Ground's Life Sciences Division is world class," said Paula Krauter, a microbiologist at LLNL. "We have run several tests there over the years and each one has benefited our spore fate and transport research."

The test employed a simulant for anthrax --- *Bacillus globigii* (BG), a benign bacterium. *Bacillus globigii* has long been used as a simulant for anthrax because its spores behave similarly to anthrax but are nonhazardous.

Three common materials used for ducts were evaluated: flexible plastic, galvanized steel and internally insulated fiberglass. A number of trials were conducted with each medium.

A replica of a typical HVAC duct was constructed, with a chamber filled with BG at one end and a vacuum at the other to draw the simulant along the 35-foot duct. Samplers were placed along each duct to measure airflow, temperature, relative humidity and the number of BG spores as they passed.

Tests using this apparatus provide data that will be critical for determining the fate and transport of weaponized spores.

The vacuum was turned on and off at specific intervals, to better mimic the typical airflow found in HVAC ducts.

Ultimately, it was determined there is a significant difference in how an actual biological agent deposits and resuspends on each of the three materials --- flexible plastic, galvanized steel or internally insulated fiberglass. Transport efficiency ranged from 0.1 to 13 percent, depending upon the type of duct.

Estimates of the deposition velocity of the spores ranged up to 100 times greater than predicted, depending upon which type of duct material was used. This implies that building contamination could vary from room to room, depending on the duct material in various regions of the building. The value of this test is incalculable.

Because of the knowledge gained, medical and investigative personnel may be able to estimate the risk or degree of exposure among occupants of different offices in the same building. The study by LLNL may also help to determine areas most likely contaminated.

As a result of the test, transport and remediation models to estimate the spread of a biological agent along ducting may be revised to greater accuracy.

The test was not limited to duct studies, however. West Desert Test Center scientists, alongside their LLNL counterparts, released BG into a mock office and allowed its spores to settle overnight. The next day, samples were taken at various places in the mock office, from various surfaces, to evaluate a new rapid viability test protocol for environmental samples.

To speed facility restorations, it is essential to improve efficiency when analyzing environmental surface samples. Scientists at LLNL are adapting a new method for use in facility restoration. The assay is based on a highly specific, real-time, viable polymerase chain reaction (PCR) method.

Polymerase chain reaction is a fast and inexpensive technique used to make many copies of small segments of DNA. This is necessary because methods used for analyzing DNA may require more DNA than found in a typical sample. By analyzing the DNA, the exact biological agent and its strain may be identified.

In the event of an actual biological attack, information gleaned from the mock office test could be used to determine which areas pose the greatest or least risk, and the thoroughness of the remediation process that follows after exposed personnel have been removed.

Ultimately, what appeared to be a simple test --- pulling a simulant along various ducts by vacuum and sampling along the way – could mean saving lives, time and resources after a biological attack or incident.

Photo by Al Vogel

Polymerase chain reaction is a fast and inexpensive technique used to make many copies of small segments of DNA.

JBPDS

JOINT BIOLOGICAL POINT DETECTION SYSTEM

By Katherine C. Gandara, Chief of Public Affairs Headquarters, Air Force Operational Test & Evaluation Center

Sometimes our biggest fears can come from something so small it cannot be detected with the human eye. Chemical and biological weapons use some of the most dangerous chemicals and diseases known. These weapons are at the forefront of terrorist threats to world safety and peace. Many believe that it is no longer a question of if a chemical biological terrorism attack will occur against America but merely a question of when.

The experts at the Air Force Operational Test and Evaluation Center (AFOTEC) Detachment 1 Chem/Bio Branch, located at Kirtland AFB, N.M., are testing a system designed to enhance the survivability of U.S. forces faced with biological warfare threats. The Joint Biological Point Detection System (JBPDS) is a suite of electronic equipment, mounted in Service-specific platforms to detect and identify airborne biological threat agents.

The Air Force Operational Test and Evaluation Center, is responsible for testing new systems developed for multi-service use under operationally realistic conditions.

Biological weapons can be broken into three specific types - bacteria, viruses, and toxins. Many of these naturally occurring diseases have been modified or weaponized to increase their lethality. The most commonly discussed biological agents include anthrax, Ebola, botulinum toxin and smallpox. The primary purpose of the JBPDS is to limit the effects of biological agent attacks by providing commanders with a warning that an attack has occurred, allowing personnel to take protective measures. The system is also designed to identify the specific biological agent used in the attack and collects a sample from the air to assist medical personnel in determining the appropriate treatment if an exposure has occurred.

The JBPDS will be used by all Services and comes in four variants that include the Air Force man-portable and trailer, the Army shelter and the Navy shipboard variant. The system can be fielded as a stand-alone version or integrated into other nuclear, biological, and chemical (NBC) platforms, such as the Army's Stryker Light Armored Vehicle and the Marine Corps Joint Service Light NBC Reconnaissance System.

"The JBPDS is a system designed to provide commanders with frontline knowledge to effectively mitigate after-effects of biological warfare agents and was developed to provide the military with a system that can be rapidly deployed anywhere in the world," said 1st Lt. Dave McGraw, AFOTEC's JBPDS test director.

A key design element of the JBPDS is that it provides automatic detection and identification of airborne biological agents at very low levels, triggers local and remote warning systems, and communicates threat information over standard communication systems, all without a man in the loop.

"Most of the biological agent detection capabilities that the four Services currently employ are manpower-intensive systems," said Mr. Craig Jessen, an analyst with Science Applications International Corporation providing test planning and execution support to AFOTEC. "The JBPDS is designed to automate many of the functions that currently must be performed manually, freeing military personnel to perform other critical duties."

Using laser-induced fluorescence, the JBPDS detector continuously evaluates the atmospheric background for traces of potential biological agents. When the system detects something of a suspicious nature, the system's collector is initiated to take in hundreds of liters of air per minute, concentrating the aerosolized particles into a small liquid sample. This sample is then processed by the JBPDS using an automated reader assembly that employs immuno assays (similar to a litmus strip) for specific biological agents. If the assay shows signs of a biological agent, an alarm is sounded and a portion of the collected

sample is provided for further laboratory analysis. The entire operation is automated.

The JBPDS can be operated either as a stand-alone system with on-site operators, like the Army's shelter variant, or, in the Air Force operating concept, deployed in defensive monitoring arrays with numerous systems around an airbase and controlled from a wing command post or survival recovery center. The JBPDS is not a standoff system that will warn of an approaching biological warfare cloud but instead is a "detect-to-treat" system allowing for the timely initiation of medical treatment following a biological warfare attack.

"Rapid identification of the point of origin is critical so persons exposed to the agent can be identified, contacted and treated. The sooner treatment starts the better their chances are of survival," Jessen said.

The AFOTEC has led the test planning, execution, and reporting efforts for the $1.2 billion JBPDS program since 1998. The program has completed several phases of testing and included more than 300 personnel from 38 agencies in the Department of Defense including the Air Force, Army, Navy and the Marines Corps.

The first operational tests of JBPDS took place in 1999 with an Operational Utility Evaluation. This was a component-selection test to determine the type of detector to be used with the system. This test resulted in the decision to use the Biological Aerosol Warning Sensor detector instead of the flow cytometer detection component because of its better performance. In 2000, an Operational Assessment was conducted which resulted in a decision to eliminate one of the variants and redesign another. A second Operational Assessment followed in 2001 which led to the decision to introduce a fourth variant, a trailer and also supported a decision for low rate initial production of JBPDS for subsequent testing.

In late 2002, the first phase of a six-phase Multi-service Operational Test and Evaluation was conducted and resulted in the Army creating a company and fielding 35 JBPDS shelter variants. A year later, AFOTEC led the way for the first operational biological field test conducted outside the West Desert Test Center, Dugway Proving Ground, Utah as AFOTEC and the Army Test and Evaluation Command jointly conducted Phases II, III, and V of the Multi-Service Operational Test and Evaluation (MOT&E) at Eglin AFB, Florida, from October through December 2003.

Soon after, in January 2004, the Navy tested the shipboard JBPDS variant aboard the USS The Sullivans off the coast of Florida.

Since actual biological warfare agents cannot be released into the open air, operational testing of the JBPDS has been accomplished using aerosolized simulants that have similar physical properties as the agents, but not the harmful effects. The AFOTEC test team developed the biological warfare simulant dissemination and referee methodology necessary to enable the JBPDS testing at Eglin AFB and acquired the simulant disseminators, aerosol referee instrumentation and laboratory equipment used during the test program. This was possible because of the different areas of expertise team members bring to the test program. The test team includes AFOTEC Detachment 1 Government and contractor personnel as well as support from AFOTEC's Test Support, Operations, Plans, Programs and Policy, and Air and Space Mission Directorates.

"Within the detachment, we have established a biological warfare testing capability," said Mr. Bob McGhin, AFOTEC Detachment 1 JBPDS biological operations director. "This includes biological warfare simulant dissemination, referee and complex analysis of biological warfare simulant clouds."

What does the future hold for the JBPDS system? Units are currently being built and fielded to the Army to provide biological warfare defense in high-threat areas of the world. The system will also undergo additional laboratory testing over the next two years to determine its capabilities against various aerosol concentrations of biological warfare agents. AFOTEC is also busy preparing for the sixth and final phase of the JBPDS MOT&E. Since, the Eglin AFB testing in 2003, AFOTEC has been involved in a community-wide effort to develop improved simulants for field testing. The new simulants being investigated are derivatives of vaccines for the biological agents and are intended to more closely mimic the physical properties of the actual agents.

Over the next two years, AFOTEC will be developing the methodology needed to disseminate and referee these new simulants in order to execute Phase VI of the JBPDS MOT&E in 2007.

Against the backdrop of the war on terrorism, AFOTEC Detachment 1 evaluates the JBPDS that will provide a common capability for individual Service platforms. JBPDS' ability to provide early detection and identification of biological agents within the theater of operations will increase the effectiveness of U.S. forces by limiting adverse impacts on operations and logistical systems.

The JBPDS detection suite integrates and identifies, triggers, samples and detects for real-time detection and identification of biological agents.

School Launches Biological Warfare

The Army Medical Department Center and School's (AMEDDC&S) newest multi-Service course teaches its students the inner workings of a cutting-edge biological warfare identification device.

The first formal Joint Biological Agent Identification and Diagnostic System (JBAIDS) Course, taught at Brooks City-Base, TX, started July 2005 with 24 military and civilian students from military installations throughout the world.

The students' job titles range from microbiologists and medical laboratory technicians to preventive medicine and food inspection specialists. But while their uniforms and jobs may vary, all have something in common – JBAIDS.

JBAIDS is the latest weapon in the race to identify biological warfare agents quickly and accurately. It used to take the military two to four days in a microbiology laboratory far from the detection site to identify a biological warfare agent. JBAIDS can do it near the site in about an hour.

"This is the first Department of Defense laboratory system for confirmation of biological threat agents in the field," said Jim Murray, JBAIDS course director.

"The quicker we can identify an agent, the quicker a doctor can make an accurate diagnosis and commanders can start taking action," said Donna Boston, JBAIDS System Manager.

JBAIDS is not just quick, it's accurate. The system's sensitivity, or ability to accurately identify specimens containing an agent, averages at least 85 percent per test, and its specificity, or accuracy in pinpointing the percentage of specimens without an agent, has averaged at least 90 percent, according to Maj. Harry Whitlock, AMEDDC&S combat developer.

New Class for Identification

(Joint Biological Agent Identification and Diagnostic System)

By Elaine Wilson, Fort Sam Houston, Public Affairs Office

"With rapid identification of a threat, we can be armed with information to fight bioterrorism," said Boston. "The quicker we can identify an agent, the quicker a doctor can make an accurate diagnosis and commanders can start taking action."

Since JBAIDS is a Department of Defense-run project, each military branch had a hand in its testing and adaptation of the civilian-based technology for military use.

Training was one of the many tasks that fell to the Army. The training role was a "natural addition to the AMEDDC&S," Murray said.

Officials looked at different ways to conduct training," he said. "We needed a quality schoolhouse and the consensus was AMEDDC&S. Its reputation made it an obvious choice."

The 10-day class is a crash course in JBAIDS technology, procedures and maintenance, and includes instruction in biological agents, laboratory procedures for testing threat analyzer during training at Brooks City-Base, Texas.

"Some students have been exposed to this type of technology but many have not," said Murray. "It's our job to bring everyone up to speed. We designed the training for the novice so it shouldn't present an overwhelming challenge for anyone."

After initial training, students are able to operate the system, which is small enough to slip into a rucksack, in a fixed or mobile laboratory facility that can travel downrange where the greatest threats exist.

Currently, however, there are only a handful of systems dispersed throughout the Services for students to use. While operational testing has been overwhelmingly successful, the device is still awaiting a green light from the Joint Program Executive Office for Chemical and Biological Defense before full-rate production can begin. If approved, JBAIDS will enter full-rate production in the next few months and the Department of Defense will distribute up to 450 systems throughout the Services over the next three years, according to Boston.

Murray said he is hoping and planning for the best training possible.

"We're already planning the course's evolution," he said.

Since only a limited number of devices are on hand, and the use is on an infrequent basis, former students' skills can quickly degrade. Murray said course instructors are developing sustainment courses with the need for skill maintenance in mind.

"We're planning to send out Compact Discs with a variety of refresher topics to former students and are also developing a proficiency test program," he explained.

The proficiency test will require students to analyze a sample sent in the mail with a pre-approved proctor ensuring students accurately identify the "agent."

"This will help keep their skills sharp," Murray said.

The course will evolve as JBAIDS does the same. The device can currently identify up to 10 different biological warfare agents in a given sample, including smallpox, anthrax, plague and encephalitis. The next step for JBAIDS is the addition of toxin detection and, in a few years, the development of a handheld version. The course will mirror this growth.

"We're already starting the acquisition process for a toxin identification system," Murray said. "Once the system is fully developed, we'll add training for analysis of toxins to our existing training course."

The ultimate goal is to obtain Food and Drug Administration licensure, something that will help launch JBAIDS into military fixed and deployable medical facilities as a diagnostic tool and into DoD veterinary food laboratories for testing of food and water supplies. Murray said the AMEDDC&S is prepared to train enough users to handle the future workload.

In the meantime, Murray said his focus remains on bringing future JBAIDS' users up to speed.

"The technology has the potential to save countless lives," he said. "Our job is to ensure the laboratory technicians have the skills they need to make that happen."

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JBAIDS BLOCK II FLY-OFF

By Donna Boston, JBAIDS System Manager

The Joint Biological Agent Identification and Diagnostic System (JBAIDS) Team from the Medical Identification and Treatment Systems Joint Product Management Office (MITS JPMO) at Joint Project Manager Chemical Biological Medical Systems sponsored a laboratory demonstration "fly-off" of biological warfare toxin identification technologies. The Life Sciences Test Facility at the West Desert Test Center, Dugway Proving Ground, Utah, led the testing efforts from August 15 – 26, 2005, with scientists from Joint Service Government and military research installations and academia participating as independent observers.

The fly-off will be used as a technology assessment of the participating candidate systems to evaluate their potential for meeting the JBAIDS Increment II requirements. Key requirements are for rapid (< one hour) confirmatory identification of at least five biological warfare toxins in various sample types with assay sensitivity (rate of correct determinations) of at least 85 percent and false positive rates of less than 10 percent, in a field-deployable weight and footprint. The U.S. Food and Drug Administration (FDA) clearance for use as a diagnostic tool will be sought. Results of this fly-off demonstration will help establish a baseline of commercial-off-the-shelf toxin identification systems available for Department of Defense acquisition, and may result in a JBAIDS Increment II source selection effort this Fall.

The demonstration challenged six commercial off-the-shelf immunoassay-based systems with Ricin, Staphylococcal Enterotoxin B (SEB), and the interferent ovalbumin, in two clinical sample types, urine and serum. Technologies ranged from hand-held assay panels with digital scanners to complex

Luminex

Idaho Tech

biological array systems. A total of 580 samples were tested in labs inhabited by each of the six competing companies: ANP Technologies, Inc., BioVeris Corporation, Constellation Technologies, Idaho Technology, Inc., Luminex Corporation, and Meso Scale Diagnostics LLC. At the completion of each day of testing, the companies turned in their system's results.

The JBAIDS program constitutes development of the DoD's first common medical diagnostic test platform among all the military services that will both confirm the presence of biological warfare (BW) agents and toxins and be used as a diagnostic tool by medical professionals. A spiral development and fielding approach is being pursued by the JBAIDS program office for incremental capability upgrades. The Block I program consists of the development and validation of BW agent identification hardware and assay kits, along with production options for manufacture, integration and fielding of complete JBAIDS sets. The Block I system set includes the hardware and software platform, assay kits specific to 10 BW agents, and sample preparation protocols, and a clinical trials data package for the anthrax assay is currently under review by the FDA.

As Block I nears its full-rate production decision and initial fielding dates in Sep/Oct 2005, the focus has now shifted to the next capability upgrades. This fly-off and baseline of toxin identification technology were the first steps in moving toward potential development efforts in FY06.

This was the second time the JBAIDS Team has turned to the Life Sciences Test Facility (LSTF) at Dugway Proving Ground for a fly-off. The first was in August 2002, for the Block I program to compare candidate technologies for BW agent identification. Eight contractors participated in that event. The results of that fly-off were used in the JBAIDS Block I source selection. (The LSTF, tasked by the US Army Developmental Test Command, has also conducted the JBAIDS Block I assay developmental testing from 2004 through 2005.)

The JBAIDS System Manager, Donna Boston, expressed strong satisfaction with the testing and technical support LSTF provided, and stated that the MITS JPMO will continue to choose LSTF for test demonstrations and technology assessments whenever possible. According to Boston and her team, all of whom participated in the fly-off, the knowledgeable, professional scientists and test support staff, excellent test facilities, and can-do attitude of the range support personnel make the LSTF at West Desert Test Center a highly desirable place to conduct these sensitive bio-warfare test events.

(Prepared by: Donna Boston, JBAIDS System Manager, JPMO MITS, Office of the Joint Project Manager Chemical Biological Medical Systems, 64 Thomas Johnson Dr., Frederick, MD 21702, donna.boston@us.army.mil)

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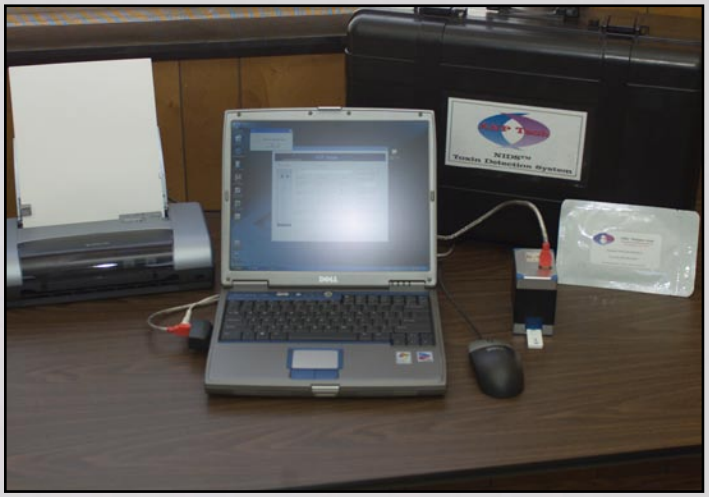

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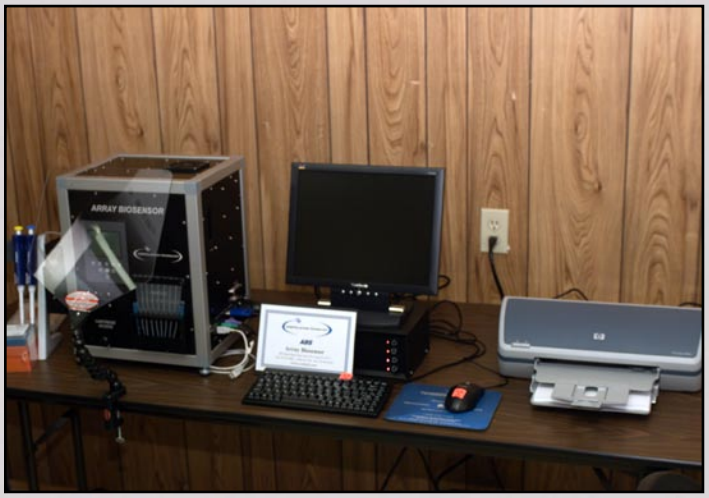


Constellation Tech

CLANDESTINE MANUFACTURE OF CHEMICAL WARFARE AGENTS

By J. Lawrence Rak, PhD, Camber Corporation

How could a nation manufacture enough nerve agent to make chemical warfare an integral part of its military strategy and keep this fact from the eyes of the rest of the world? How could the same nation clandestinely replace its inventory of agent as portions of it are used or become inactive, so that it is always ready to use in a military campaign? The terrifying truth is that developing and maintaining a clandestine chemical weapons arsenal is not only possible but, with the right amount of care and attention to detail, relatively easy to do.

A successful concealment strategy has three key elements: minimal time, maximum cover and multiple locations. Careful consideration of the nature of chemical agents and their manufacturing reveals how these conditions can be met.

Nerve agents are closely related chemically to insecticides. The same process equipment used to make pharmaceuticals, herbicides or specialty chemicals can also be used to make chemical agents. Therefore, the ability to make those types of chemicals or the availability of this type of equipment immediately suggests the potential to make chemical warfare agents. Any nation possessing the technological ability to manufacture these essential and beneficial types of chemicals within its borders can become a player in the chemical warfare game.

Before we go any further, we need to discuss quantity, size and location. To meet the strategic necessities for maintaining secrecy, the nation in question needs to successfully manipulate the following three elements.

The first element is quantity. If the nation in question wants to make chemical warfare an integral part of their military strategy, they would need to keep on hand an inventory of about 20,000 chemical artillery rounds, each holding about one half gallon (two liters) of nerve agent [1]. Calculations show that to replenish their inventory to account for agent and munition deterioration at a rate of 20 percent replacement per year, they need to produce 2,000 gallons (about 20,000 pounds) of agent annually. In addition, if a nation is not currently engaged in chemical agent manufacture, but instead seeks chemical warfare capability within five years, that rate of production is ideal.

The next element is size. Chemical manufacturing equipment typically comes in three size ranges. For the type of process used to make chemical agents, full-scale industrial production is usually handled in equipment of 1,000 to 3,000 gallon size. Testing of new processes before they are committed to full-scale production is performed in what is called semi-works equipment, which is usually 300 to 500 gallons in size. Finally, testing of developmental, unproven processes is performed in a pilot plant, which typically has 50 to 150 gallon equipment.

The final element is location. Any established manufacturing site will certainly have full-scale equipment on hand. Many, if not most, sites of this type will also contain a semi-works facility. A research and development facility will contain a pilot plant, and may very well exist in conjunction with a larger chemical complex that handles semi-works and full-scale production as well.

It is now important to address how a typical chemical process for making chemical agents looks. These substances are complex in structure, so they require several (usually four or five) separate chemical steps to produce. Each step requires different raw materials and each produces an intermediate chemical for the next step in the process [2].

Invariably, byproducts and contaminants are also made in each step, and these need to be separated from the desired intermediate or final product. This results in a manufacturing process containing as many as seven to 10 individual steps, including purification operations and disposal of unwanted byproducts or contaminants. Each of these steps would require about four to six individual pieces of manufacturing equipment, for a total of 30 to 60 equipment items in a single plant [3]. Keeping a plant of that size and complexity a secret is not easy if all that equipment is together in one place. Dispersing that activity over multiple locations would certainly make it less noticeable. Finished intermediate from one step could be trucked to another location for further processing.

One inescapable fact that drives the strategy for making agents is the increasing toxicity of the chemical intermediates made in each step. The initial or earlier intermediate products may be relatively benign, while, of course, the product from the final step, the agent itself, is extremely toxic. It therefore stands to reason that the intermediate products become more and more toxic as the process unfolds. This means that greater care in manufacture to prevent accidental release of toxins must be taken with each succeeding step.

However, this also means that larger quantities of the less toxic materials can be safely and easily handled in the early steps and larger-size equipment can therefore be used.

As such, the prudent method would be to make the relatively safe materials coming from the initial manufacturing steps in the largest equipment available. Engineering calculations suggest that it would take as little as 10 days to produce enough chemical intermediate to support the required 20,000 pounds per year production rate. That includes time for preliminary start-up and final clean-up activities. The start-up work might involve some piping changes and installation of a few small pieces of equipment. The final clean-up would involve flushing the equipment and disposing of the residue.

If the facility is engaged in year-round production of, say,

CTURE OF

insecticide using raw materials similar to those used for agent production, it would be relatively easy to disguise ten days of secret activity in a year's worth of normal production activity. Considering the chemical reactions involved in agent manufacture, 4-15 tons of each raw material would be consumed during agent manufacture versus 140-600 tons of similar raw materials consumed during the rest of the year in a full-scale plant. The amount of contaminant or byproduct to dispose of would also be about 1/40 of their annual disposal load. This ought to be relatively easy to hide from prying eyes. Here, minimizing time and maximizing cover are both accomplished.

Lastly, running a single plant all year round making the same product day in and day out would be easy to detect. Delivery of raw materials into the plant and shipment of product out of the facility could easily be tracked with aerial or ground surveillance. Once the raw materials are identified, what is being manufactured in that plant becomes grimly evident. Cover must be provided to prevent detection.

With greater care in manufacture being required for later steps, a scale-down of equipment size would make sense. Later steps could easily be run in semi-works size equipment. Usually this equipment, which must be very easily adaptable to different processes, would be in a building or facility where many different processes are tested. There would be a great variety of raw materials brought to it in portable containers (totes) or drums on palettes, which would not be easily identified. If the same calculations performed above for a full-scale plant are applied to the smaller equipment, a single 20 day campaign or two 10 day campaigns in a semi-works plant would be enough to sustain that 20,000 pound per year production rate. These short campaigns, using the minimum practical production time, could easily be covered by four or five similar test campaigns, where trial processes to make other conventional chemicals are conducted.

All this can be accomplished in one location, if it contains a great variety of equipment sizes. Intra-plant traffic of intermediates from one building to another by tote or drums may be difficult to trace. But, having the facilities at substantial distance from each other has the advantage of increasing dispersion of the activity. In this case, the necessary inter-plant trucking of intermediates must be disguised. Keeping this traffic on an irregular schedule is another effective concealment method. How to manage this transition is a matter of judgment, with how best to guard secrecy (maximize cover) the prime factor in making that call.

Surely, all bases have not been covered in this writing. Using one or more hard dug-in facilities in remote locations solely for agent production has its pluses and minuses and needs to be considered. Blister agents have not been discussed. Alternate delivery means, such as aerial bombs or missiles are also possible. Subsequent articles will deal with those issues as well as making and handling the final products, which, after all, are some of the most toxic substances known to man.

A successful concealment strategy has three key elements: minimal time, maximum cover and multiple locations.

Footnotes:

1.Iraq: Potential for Chemical Weapon Use (CIA monograph at www.fas.org/irp/gulf/cia).

2.Simak, Richard S., Vital Physical Properties of the Precursors, Intermediates, and Manufacturing Byproducts of the Chemical Warfare Agent GB, Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD, June 2002.

3.Simak, Richard S., Vital Physical Properties of the Precursors, Intermediates, and Manufacturing Byproducts of the Chemical Warfare Agent VX, Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD, June 2002.

Dr. Rak is currently under contract to Camber Corporation (Abingdon, MD) to provide training assistance to 22nd Chemical Battalion at Aberdeen Proving Ground, MD. He can be contacted at jlrak@comcast.net.

One inescapable fact that drives the strategy for making agents is the increasing toxicity of the chemical intermediates made in each step.

ENZYMES INTERDICT NERVE AGENTS IN 'BIOSCAVENGER' PROGRAM

By Karen Fleming-Michael
U.S. Army Medical Research and Materiel Command Public Affairs

Human plasma and goats may one day hold the key to protecting warfighters and the public from nerve agents.

Boosting the amounts of an enzyme called *butyrlcholinesterase*, normally present in small quantities in blood plasma as a detoxifier, can increase the effectiveness of the enzyme in interdicting nerve agents when they enter the bloodstream so the nerve agents can't reach their targets.

Knowing this, researchers have been finding ways of producing large amounts of the enzyme they call a "bioscavenger." Researchers at the U.S. Army Medical Research Institute of Chemical Defense (MRICD), working jointly with the Walter Reed Army Institute of Research (WRAIR) in Silver Spring, Md., have looked at three concepts of the bioscavenger. The most mature version, *butyrlcholinesterase* isolated from human plasma, has transitioned to the Chemical Biological Medical Systems Joint Project Management Office (CBMS JPMO). CBMS is the DoD advanced developer for medical chemical/biological defense products and reports to the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD).

Col. Michelle Ross, Deputy Commander of the MRICD in Aberdeen Proving Ground, MD, said that the objective is to develop a pretreatment that is broad spectrum and will work against all known nerve agents.

Ross said the bioscavenger approach is revolutionary because it works by preventing and destroying the nerve agent entering the body before it can reach its physiological target.

"The plasma-based protein is made in people, so it's expected to be compatible with people."

Ross stressed the enzyme will help the warfighter during field operations if chemical agents are encountered.

"(Current) nerve agent antidotes all enhance survival and, in the best cases, reverse the toxicity of exposure, but they cause a performance decrement, and the recipient becomes a casualty (who needs to be) evacuated to a military treatment facility," she said. "In an operational context, what the combatant commander wants is a warfighter to continue the mission, not be a casualty, not be a logistical burden to the health care system but keep on trucking - the bioscavenger [will help] address that concern."

Use of the bioscavenger is similar in concept to the use of gamma globulin shots that travelers have taken for more than 50 years to boost their immunity.

"It's a passive protection," said Dr. David Lenz of MRICD . "You will be protected as soon as you get the shot and achieve adequate plasma levels if you're subsequently exposed to... nerve agents."

Researchers hope to get Food and Drug Administration approval for the plasma-derived bioscavenger version first. In a ground breaking cooperative effort between DoD and the Department of Health and Human Services (DHHS), DoD/CBMS contracted with Dynport Vaccine Company LLC (DVC) and Baxter Healthcare Corporation on April 6, 2005, to conduct process development efforts and produce small scale batches of the plasma-derived bioscavenger that are easily adapted to large scale production under conditions that will meet FDA approval. The small scale batches will be used in a preliminary human clinical

safety trial. If the trial is successful, the product and the technology to produce the product may transition to DHHS for possible Project BioShield funding, the President's 2003 initiative that encourages companies to develop bioterrorism countermeasures. This would allow DHHS to move the product toward full FDA licensure.

Because a liter of human plasma contains just a couple milligrams of the enzyme, there's not enough plasma to meet demand. Therefore, researchers are investigating bioscavenger's second generation form. One candidate uses recombinant technology to create the butyrlcholinesterase enzyme. Nexia, a Canadian company recently purchased by PharmAthene Inc., created genetically altered nanny goats that produce the enzyme in their milk. Their offspring also inherit that ability. A liter of the goats' milk may contain as much as one to three grams of the enzyme.

"This potentially gives us a [much larger] source of the enzyme," Ross said "The objective is to have enough enzyme available for not only the Department of Defense, but also to support a requirement for the civilian population of the United States, hence the need to go with a different developmental strategy."

Lenz said as with adaptation of any new technology, one always proceeds with cautious optimism.

"It is indeed a human protein bioscavenger that's produced in the milk, but there are subtle differences in the form it takes versus the purified form that comes from human plasma", he said.

Because it comes from a goat and not a human, the enzyme may be a little different in terms of its structure, said Dr. Ashima Saxena of WRAIR. "The question is whether the material works differently because of these slight differences in chemical structure."

"The plasma-based protein is made in people, so it's expected to be compatible with people," she said. "Goats are different. The milk-based protein, because it's made in goats, may cause a potential reaction."

"The objective is to develop a pretreatment that is broad spectrum and will work against all known nerve agents."

While researchers are determining if the goat-derived bioscavenger is as effective as the human-derived form, they're also exploring a third approach to harvesting bioscavenger. They're interested in a catalytic form of the bioscavenger whose molecules bind not just one on one with nerve agents as the current bioscavengers do, but one that would speed up the breakdown of the nerve agent in the bloodstream and is able to do this again and again.

"When you have the situation where you have one-to-one binding, a large amount of the enzyme is needed for a small amount of nerve agent," Lenz said. "If you can get something that can continuously destroy nerve agents for as long as it's in circulation, you can use less of it and improve its ability to protect."

Researchers have several proteins that they think hold promise, including a mutant form of the bioscavenger whose amino acid sequence is altered so it catalyzes the breakdown of the nerve agent. They're also looking at a naturally occurring human enzyme called PON, for paraoxonase, which catalyzes the breakdown of the nerve agents sarin, soman and VX.

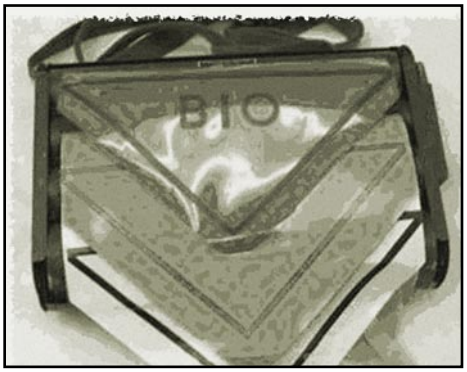
"You're better off going with Mother Nature," said Dr. Bhupendra Doctor of WRAIR. "Enzymes that scavenge or hydrolyze organophosphates are all 'universal' antidotes, but when you go the mutation route, you have to add five to 10 years to the project because technologically it becomes more difficult. I think we will find a catalytic scavenger; we just haven't looked hard enough."

There is a lot of interest in the bioscavenger program," said LTC Keith Vesely, Joint Product Manager, Medical Identification and Treatment Systems, which is part of CBMS and responsible for managing the advanced development of bioscavenger. "We are supporting the development of the plasma-derived product with DHHS and will be starting a program this fall to develop a second generation bioscavenger. The drug development process is long and involved and success is not guaranteed; however the benefits are well worth the effort."

Improved Individual NBC

Maj. Rodney D. Faust, Assistant Program Manager, NBC Reconnaissance and Platform Integration
Photo credit: Courtesy of the U.S. Army Chemical Corps Museum, Fort Leonard Wood, MO

The M274 Individual Nuclear Biological Chemical Marking Set (Contamination Sign Kit) has been in the U.S. Army for more than 25 years without any changes or improvements. Prior to its fielding to the US Army, the marking set had been in use since 1958 in the German Army. The Marking Set was acquired from the German army in December 1979 for evaluation to meet the conditions of an Army Letter Requirement (USA TRADOC CAN 51166). The purpose of the evaluation was to help the Army find a solution for standardizing its NBC contamination marking during combat and field training operations. Even though Standard NATO Agreement 2002 established a standard for NBC Marker Signs, the practice in the U.S. Army at the time was to locally manufacture or purchase markers. This practice led to a number of variations in markers made from different types of material with varying degrees of quality. Selecting a marking system would standardize the markers and create a cost savings to the Army due to the large quantity of systems needed.



M274 Individual NBC Marking Set

The German army marking set was adopted as a solution because it satisfactorily completed an International Material Evaluation test conducted by U.S. Army Test and Evaluation Command in February 1981. Other reasons for selecting the German Marking set were that it was usable by any Military Occupational Specialty (U.S. Army), required very little maintenance, was expendable, had a low cost and saved money on developmental costs.

Twenty-five years later, these same marking sets are still in use. Several attempts were made during the 1990's to improve the set; however, none have succeeded until now. In September 2005 the Product Manager (PM) for NBC Reconnaissance, Lt. Col. Daniel McCormick, decided it was time to make a change and set in motion a plan to improve the NBC Marking Set. The goals of this venture were to:

1. Make the set Modular Lightweight Load - Carrying Equipment (MOLLE) compatible
2. Make the set Joint compatible
3. Increase the capability of the set
4. Increase the functionality of the set
5. Make the set modular
6. Make the set components compatible with the marking components used in Chemical, Biological, Radiological, and Nuclear Agents (CBRN) Reconnaissance Vehicles
7. Use commercial products in the set to

Marking Set

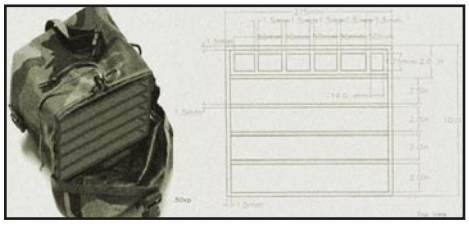
lower the costs

Besides being obsolete, the current marking set lacks functionality; it is not MOLLE-compatible nor is it easy for the warfighter to use. The marking set is bulky and heavy. Because its container is metal, use of the consumables does not lighten the load and the container creates noise when carried. The current system also has multiple reliability problems. Most importantly, the signs used are not durable; they tear easily, are hard to remove from the dispenser and are easily damaged in high winds. The sign container tubes are susceptible to water damage and sometimes require the use of tools in order to pull the signs out. The stakes used in the set are difficult to insert into frozen ground, easily split apart during assembly and are too short for the flags to be seen at a distance. The ribbon used in the set is hard to tear, sometimes requiring a cutting tool, and is hard to remove from the dispenser tube. The crayon markers in the set melt in high temperatures, the marking from the red crayons is not visible in infrared or red visible light and there is no means to sharpen the crayons.

All of these factors make the existing set unreliable and a burden, not an asset, in the field. Additionally, the set is not conducive to training because of the way the flags are dispensed. Once the flags are removed from the set, they cannot be reused since they are on a dispenser "roll."

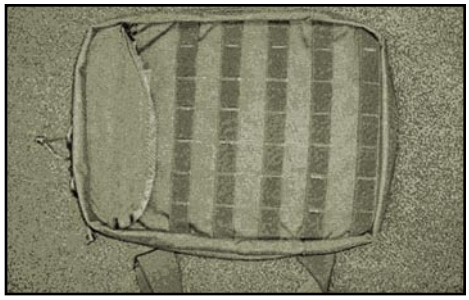
M274 Disassembled

As configured, the current (M274) marking set suffers from poor user acceptance. This lack of support is due in part to the way the set is designed. It was decided that the configuration would need to change as a part of the improvement program. The current set contains four main components: 48 metal ground stakes, 852 feet of ribbon, 60 plastic flags and two crayon markers carried in a metal container and having a combined weight of 10 pounds. Because of the design, a metal box and components, the marking set is cumbersome to carry and lacks modularity. An improved design needed to offer more modularity and better ergonomics.



Prototype Concepts

To incorporate modularity and ergonomics, the PM engaged academia to determine how modern materials could be used to develop a more servicemember-friendly design. A team from the University of Missouri - Rolla conducted an engineering design study and recommended a soft bag approach. This bag design offers better compatibility with the service member's individual equipment, less weight (including a decrease in weight as components are consumed), better ergonomics and modularity. With this new concept, the Load Bearing Equipment and Environmental team at Natick Soldier Center, working with U.S. Air Force and Marine Corps input, produced a design for testing. The bag is designed to be compatible with the MOLLE load-bearing system. This approach allows the bag to be carried and stored in a number of different ways, tailoring to specific missions, and the reuse of its components.



Improved Marking Set Carrying Bag

In addition, it is more compact than the current set.

Components for the new design are similar to those components in the current set, but with improvements. The new design contains 60 flags (20 Bio, 20 Gas and 20 Atom), 20 ground stakes (three-piece design) that are three feet long, 900 feet of marking ribbon, 100 zip ties, two grease pencils and 20 marking lights. The new flags are more reflective, reusable and compatible with CBRN Reconnaissance vehicles. The new stakes are longer and are designed so that the flag can be attached by a hook. The new ribbon is made out of lightweight vinyl and is more durable than the fabric marking ribbon in the current marking set. Additions to the new set are marking lights: Each set will contain 20 marking lights, 10 infrared and 10 visible lights. This configuration is changeable by the user to adapt the set to each mission. The only developmental items in the set are the flags, ground stakes and carrying bag. All the other items are commercial-off-the-shelf products.

New Marking Flags

The new marking set offers more capability and flexibility to Soldiers on the battlefield. Its components allow easier identification of marked hazard areas and offer a more user friendly system for conducting marking operations. Two of the components, the flags and lights, were selected following a Limited Objective Experiment (LOE) conducted at Fort Leonard Wood in April 2005. An LOE for the complete marking set was scheduled for late September 2005 at Aberdeen Proving Ground. This LOE consisted of a series of exercises in which the new marking set is tested against the current marking set to determine the suitability of the new design. Soldiers wearing standard combat equipment conducted patrols, hazard area marking and simulated close combat while wearing the prototype and the existing set. Because the LOE provided successful results for the new marking set, the improved set is scheduled to be fielded in January 2006.

After 47 years of service, 23 of that with the U.S. Army, the current marking set has outlived its usefulness. The modernized new marking set is a piece of equipment that is more service member friendly than the existing kit, offers more marking capability, modularity and more functionality. We hope and expect this new design will provide the Army with another 20-plus years of service.

Mike Cress and Jean Salvatore contributed to this article.

CBRN Marker Improvement

By Maj. Rodney D. Faust, NBC Contamination Avoidance

The Joint Project Manager for NBC Contamination Avoidance (JPM NBC-CA) , the Maneuver Support Battle Laboratory, and the US Army Chemical School have teamed together to modernize the Chemical, Biological, Radiological and Nuclear (CBRN) hazard marking system on the M93A1 Fox and planned CBRN Reconnaissance Vehicles. This improvement effort is called "Smart Marker." An article in Vol. 1 No. 3 (July-Sep 2004) Chem-Bio Quarterly discussed the "Smart Marker" project and the plan for completion. The goals remain the same: develop two marking systems, one that improves visibility and another that adds data storage and transfer capability.

Product Improvement Goals

Problems with the current marking system required a product improvement. Soldiers reported that vehicle drivers are often unable to see the marker and drive past it. Soldiers also reported a tendency for the marker to fall over during deployment from the Fox or in the case of high winds. The JPM NBC-CA team sponsored a University of Missouri-Rolla study and Army Battle Laboratory experiment to investigate how commercial-off-the-shelf technologies could improve current hazard markers. This experiment demonstrated that marker visibility can be improved with off-the-shelf components: flashing beacons and flags made of highly reflective material. The experiment also demonstrated data transfer and storage capabilities from a marker to a receiver. The results of the experiment fed requirements documents for the Future Combat System (FCS) and justified "Smart Marker."

The Army Battle Laboratory experiment demonstrated that while improving visibility was achievable at a low cost, developing the data transfer and storage capability would require an engineering effort and more cost. For this reason, "Smart Marker" was formed as two increments focusing on two different requirements.

Increment 1 focuses on improving the visibility of the current marking system used by the M93/M93A1 Fox and other proposed NBC Reconnaissance vehicles (STRYKER, Joint Service Lightweight Nuclear, Biological, Chemical Reconnaissance System). Increment 2 focuses on data transfer and storage. The goal for Increment 2 is the capability of storing digital data, such as a survey report or graphic, for transmission to a common operating picture. It is also intended to have the capability of warning the crew of a vehicle that they are approaching a hazard area, providing them with the marker location and information on whether the marker has been moved since its emplacement.

Test Lessons Learned

The project team conducted a Limited Objective Experiment (LOE) at Fort Leonard Wood, MO, in May 2004 focused on Increment 1 goals. This experiment addressed two questions: do the prototypes improve the visibility and are the prototypes compatible with the Fox delivery system? The results of this experiment proved that the addition of a more reflective flag and a flashing beacon increased the marker's visibility and are deployable through the existing Fox vehicle delivery system.

The experiment also showed that, although all prototype beacons and flags increased the visibility, the components still lacked functionality. Some of the commercial beacons needed hardening for the field environment, could not be fastened to the existing marker in a practicable way, or could not maintain a triangular shape under direct sunlight. The addition of the new flag and beacon increased instability, causing the marker to fall over. This negated all visibility improvements because the marker could not be seen when lying on the ground. The stability issue was critical in making the project successful.

To solve the physical stability problem, ideas from spring-loaded legs to inflatable flags were considered. None of these ideas worked. Cost also prohibited developing an entirely new marker or redesign of the vehicle delivery system. Therefore, the team chose to use as many current marker components as possible. Due to delivery system and storage constraints, the existing base was the only component that could be changed without adding significant cost. The project team consulted with a contractor (REX Systems, Chippewa Falls, WI), and engineering technicians at the RDECOM Advanced Design and Manufacturing (ADM) Laboratory at Aberdeen Proving Ground, MD. They developed a concept that called for using thin strips (Figure 1) of material attached to the base in a "+" configuration to

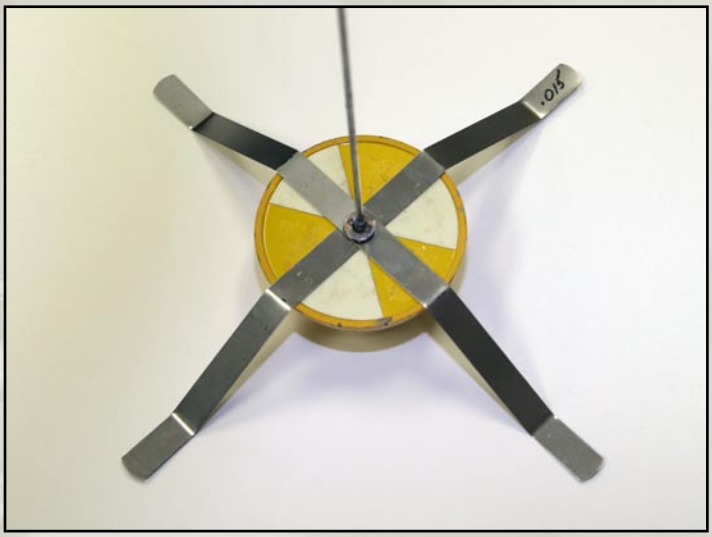


Figure 1. Base Support Prototype

help prevent the marker from falling over.

This simple approach required considerable trial and error to achieve success. The first materials used in developing the support strips were items found in the ADM Laboratory. To test various sizes and shapes of support strips, the ADM technicians developed a scale model of the Fox delivery tube. The two types of material

Project

used to develop these strips were vinyl and metal. Vinyl initially seemed a possible solution. Vinyl does not rust, is inexpensive and is easy to manipulate. But its properties, the lack of resiliency (once passed through the delivery tube, it did not spring back to the original shape) and environmental limitations (cold weather made it brittle) prohibited its use. The lack of resiliency was also a problem with metal strips except for spring steel. Spring steel is rust resistant, inexpensive and maintains its shape after passing through the Fox delivery tube. Various shapes and sizes of the metal were tested to find the optimum size for launching through the delivery tube and the right configuration that also helped prevent the marker from tipping over.

A modified marker rod was required to hold these stability strips in place requires. Technicians at the ADM Laboratory modified one of the current marker rods by welding a ½-inch washer (Figure 2) at the base of the rod to hold the tabs in place as the rod is tightened.

Figure 2. Marker Rod Modification

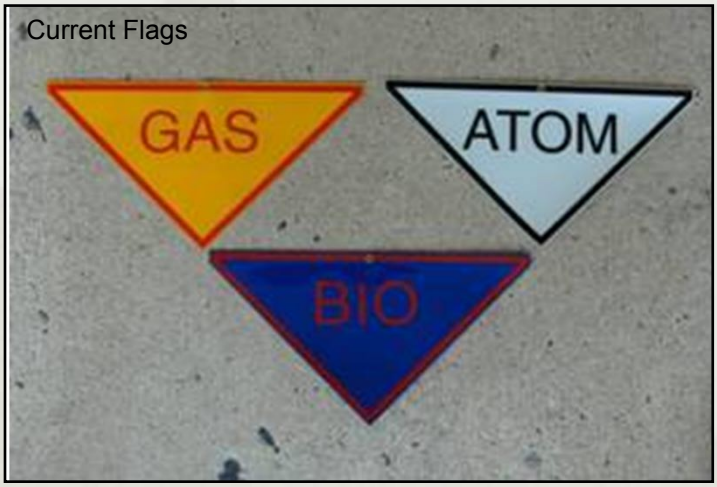
The recommended modification is inexpensive but logistically and financially challenging. To keep using currently fielded rods would require that they all be modified. Market research determined it is less expensive to develop and field new rods than to modify old ones. So for testing and development, modified rods were used, but for the final product, the team will develop new rods.

The current flags are durable but lack reflectivity. New flags need durability and more reflectivity. Existing flags were unacceptable. Market research showed that the 3M Corporation makes durable and lightweight reflective products that possibly could match the flag requirements. Safe Reflections, St. Paul, MN, delivered prototype flags with the front made of 3M High Intensity Grade Prismatic Reflective Sheeting, 3930 Series and 3M Scotch Lite Reflective Sheeting Engineer Grade for the back. These flags met all of the requirements: durable, lightweight, inexpensive, offer more reflectivity and are reflective on both sides. 3M testing showed these new flags outperformed the current flag in reflectivity, durability and cost (Figure 3).

R_a	Current Model	New Design
Front	80	500
Back	1	95

Figure 3. Comparison of GAS Flag (Yellow/Red) Visibility

They are six times more reflective on the front side and 95 times more reflective on the back side than current flags. It provides more capability than the current flag at relatively the same cost (Figure 4).



CBRN Marker Improvement

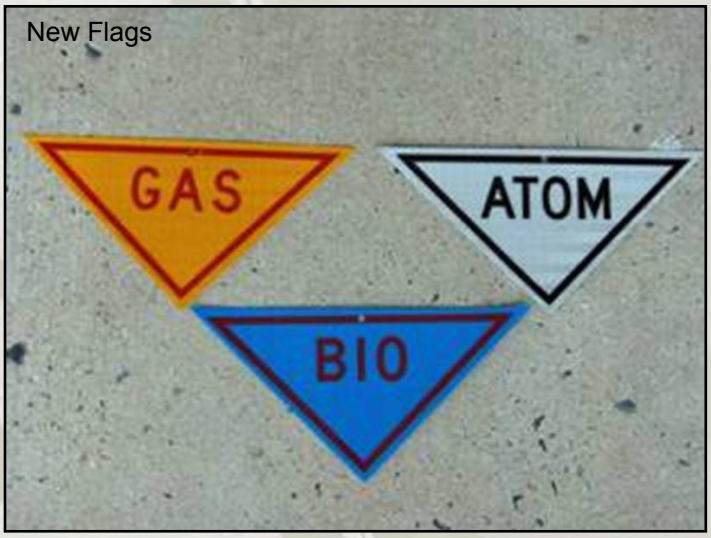


Figure 4. Old and New Flags Compared

Figure 5. Available Lights

Four factors were considered in selecting a flashing beacon; cost, durability, functionality and visibility. Originally, five lights were selected for testing. Two of these were Commercial-off-ohe-Shelf products and the other three were developed by Army laboratories at Fort Monmouth and Aberdeen Proving Ground.

The lights increased visibility, but all proved impractical in either function or cost. Market research indicated that the Mini Flasher made by Pelican Products (Figure 5), is already in the General Services Administration (GSA) system, inexpensive, rugged, meets the visibility requirements, and can attach to the marker rod without modification. The light is available in two styles: flashing infrared and flashing visible light.

Putting the Package Together

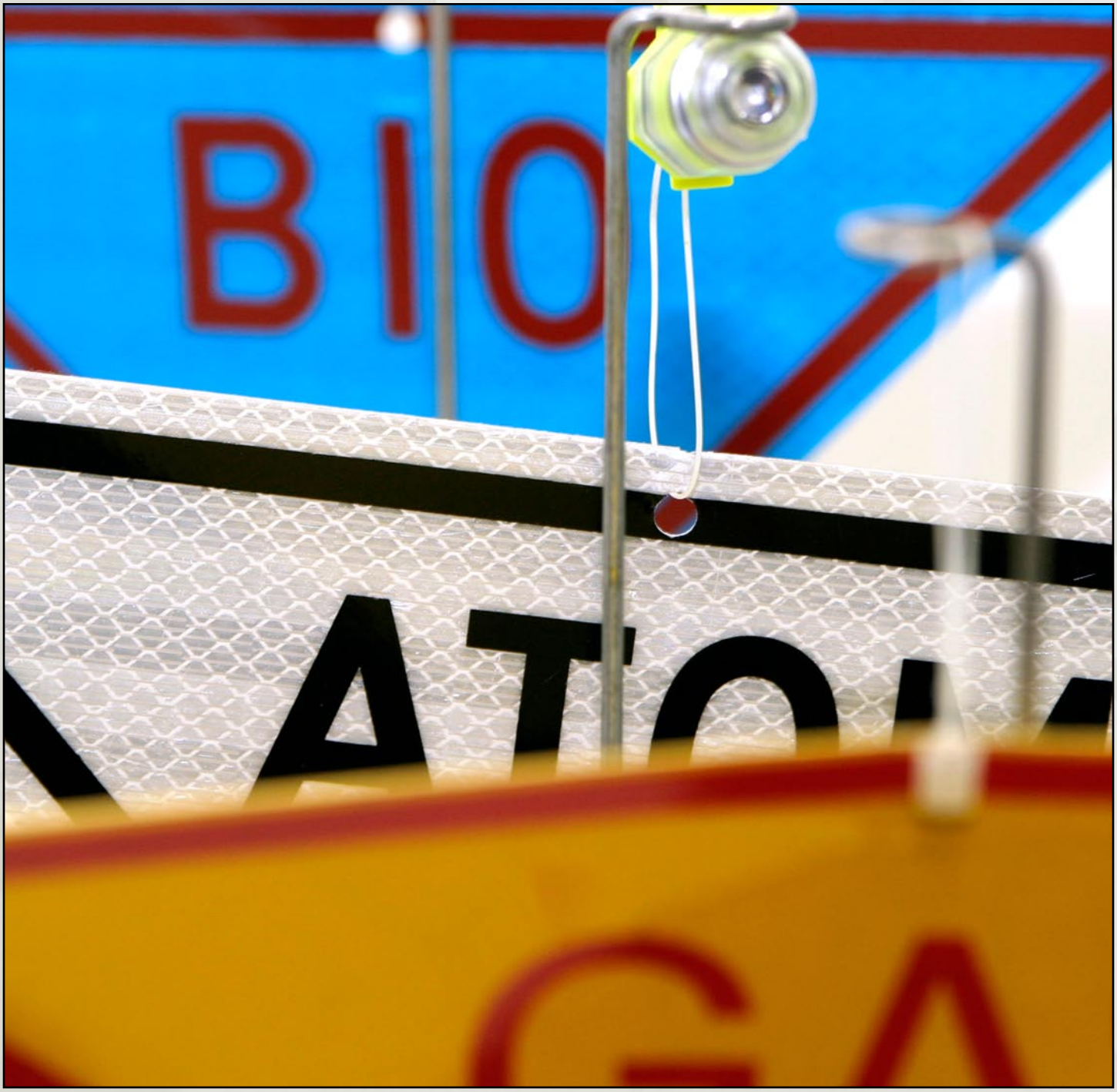
The JPM NBC-CA team combined these individual efforts to deliver an Increment 1 marker that offered much more capability for about the same cost. The new marker uses the same CBRN Fox delivery system and same storage areas as the current marker. One additional Increment 1 Marker, test was needed. This test was conducted at Fort Leonard Wood, MO, in April 2005 to look at the marker's visibility performance during day and night operations, its durability through deployment testing and its functionality through Soldier use. The formal analysis from this test is ongoing, but initial results show the new marker meets and exceeds most of the requirements. Flags were visible unaided at 200 meters at night (under moonlight), and the visible light flashing beacon was visible unaided at night from 500 meters. Using Night Vision Goggles PVS 7 & 14, Soldiers saw both the infrared and visible lights at 1,000 meters. The stability strips helped stabilize the launched base but needed some design changes to increase effectiveness. Samples of the Increment 1 marker were provided to units at Fort Polk, LA, and Fort Hood, TX, for user testing and feedback with these changes made, and with the demonstrated performance offered by the other components. The JPM NBC-CA team also provided new markers to the 51st Chemical Company for use during the 172nd STRYKER Brigade Combat Team training rotation at the Joint Readiness Training Center in May 2005 and to the 4th Infantry Division at Fort Hood, TX, for use during Operation Iraqi Freedom training preparations in June 2005.

Project

The Way Ahead

The JPM NBC-CA team will seek a production and fielding decision on the Increment 1 marker at the conclusion of these training events and after feedback on marker performance is gathered, First quarter FY 2006.

The "Smart Marker" project is a prime example of academia, industry, and the Government working together to rapidly identify solutions to critical military requirements.



Photos by Don Bitner

Perfectly Suited: Couple Finds Harmony at Home and in a High-Containment Laboratory

By Karen Fleming-Michael, U.S. Army Medical Research and Materiel Command Public Affairs

The formless, electric blue "spacesuits" worn in high containment laboratories hardly seem like they'd attract members of the opposite sex. But two researchers at Fort Detrick, MD, were able to see past the plastic worn in the Biosafety Level Four Laboratories and find their "soul mates."

Drs. Tom and Joan Geisbert, both Frederick, MD, natives, have collaborated personally and professionally for the last 20 years at the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID).

The institute has seen its share of couples who work there. In fact, the Geisberts can quickly rattle off five other husband-and-wife teams who have worked at the institute that conducts basic and applied research on biological threats resulting in medical solutions to protect servicemembers. Spouses at the institute never work for each other, but the Geisberts do work on the same lab team.

"Working together is normal," Tom said. "I can't imagine not working together because we always have." Joan, a biological laboratory science technician "in short, a BLT," she said, started working at USAMRIID in 1974, fresh out of high school. Adept in the laboratory, she moved from biosafety level three laboratories into the laboratory with the deadliest pathogens when her then-boss, Dr. Peter Jahrling, gave her the chance.

"He taught me how to do a lot of different things and had the confidence in me to tell me to go off and do something, and I'd do it," she said. Today, she's the senior alumna and "Jack of all trades" for the "hot" suite that she supervises, ensuring that every piece of equipment works and every person in the suite has skills as sharp as hers.

A microbiologist, Tom arrived at the USAMRIID in 1985 while he was pursuing his master's degree and then his doctorate from the Uniformed Services University of the Health Sciences. By 1988, he was working with Jahrling, Joan and some of the world's deadliest hemorrhagic fever viruses: Ebola, Marburg and Lassa fever.

"Joan taught me everything I know about how to wear a space suit-the whole nine yards," Tom said. "There are only so many places in the world that do what we do: Health Canada,

CDC (Centers for Disease Control and Prevention). Now they're building more of these laboratories, but it's so unique it's very difficult to go out (and get the skills) to function in a level four."

Married since 1993, the two have much in common. As youth, they attended the Frederick Church of the Brethren and can recall when Frederick was still rural. "They called it 'Fred-neck' back then," Tom said. Both were previously married, and each had two sons from those unions. The two also share long ties to Fort Detrick. His father was the building manager for USAMRIID; her family owned the cornfield where USAMRIID now stands. The little brick house on the corner of Sultan Drive and Ditto Avenue was her parent's home, and the white farmhouse behind it was her grandparent's.

"I tell people that when I'm at work, I'm always home," she said.

The two also share personality traits that make them compatible for working in a high-containment laboratory and for being married to each other. An independent streak, the ability to work for long periods hearing nothing but air rushing around in the spacesuit and the skill of mind reading are all preferred traits for working long hours in a hot suite, Tom said.

"There are physical limitations to the number of people you can put into a level four. You put in more people, you endanger the people that are there," he said. "And when you work a long time in a level four, you communicate with each other without talking."

Jahrling said that an outside observer watching the suite's four-person team in action would never suspect the Geisberts were married.

"It would look like two people doing their job," he said. "It looks like a well-seasoned, practiced, professional team." Though the couple said that working in the laboratory is the fun part of what they do, they're always aware of the threat the viruses pose.

"When you watch what these diseases do, I think it makes you even more conscious of what happens in a laboratory," Tom said. "I'm always worried that something could happen to the people in my inner circle. They're my best friends."

The Geisberts' focus and enthusiasm are the reasons why they've thrived in the hot suite, Jahrling said.

"It's like driving a car on the freeway; you'd best not nod off," he said. "The same applies here. You can't afford to have a bad day. There's an edge and an adrenaline rush every time you go in there. That's part of the allure."

What the Geisberts ultimately share are the ups and downs of working toward finding vaccines for the hemorrhagic viruses that devastate African villages and can potentially be used as biological weapons.

"In this field there are a lot more failures than successes, because these agents are level four for a reason. A lot of these agents were discovered in the '60s and '70s. If it had been easy to develop vaccines and countermeasures, it would be done by now," Tom said. "You live these failures together."

Jarhling, now with the National Institute of Allergy and Infectious Diseases, part of the National Institutes of Health, likens the early work with those viruses in the 1980s and 1990s to walking toward a mountain in the distance.

"You knew you were going in the right direction, but it didn't really seem like you were making much progress for a while," he said.

Recent years, however, have brought more good news than bad. "I remember the rush, that feeling of accomplishment, after you've watched so many failed studies and you know that you're finally getting there," Tom said. "Those are the things that Joan and I share."

Jahrling said that because the couple has the same goals in life, they balance their home and work lives.

"I would imagine there's not much discussion about 'What do you mean you've got to go to the laboratory today? I thought we were going to pick out kumquats,'" he said.

When the two sit on their deck or porch in Shepherdstown, W. VA, they admit that work goes home with them. But when it's vacation time, they leave USAMRIID at home while they travel to the Southwest, hunt, fish and camp.

The two have no firm plans to leave the institute, but if Tom leaves, Joan will follow because "we are a package deal," she said.

"I think they're absolutely hand in glove," Jahrling said. "They are the perfect match. I think they do what all married couples do: they complement each other's virtues and capabilities and pick up the slack for and motivate each other."

RICIN

By Karen Fleming-Michael, U.S. Army Medical Research and Materiel Command Public Affairs

Jack -- of beanstalk fame -- can attest to the fact that a few little beans can cause a whole bunch of problems.

Ricin, a toxin made from castor beans, makes Jack's problems look trivial and has no fairytale ending.

"Inhaling the toxin causes severe breathing problems as the lungs fill with fluids because the toxin attacks cells in the lung," said Dr. Leonard Smith of the Division of Integrated Toxicology at the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID).

Ingesting ricin causes vomiting and diarrhea that may become bloody and result in dehydration, according to the Centers for Disease Control (CDC) site. Hallucinations, seizures, blood in the urine - Jack never had to deal with those, either.

Since 1989, Smith and other toxin experts at the institute have worked on finding a vaccine to combat ricin exposure, whether it comes through the air or deliberate contamination of the food or water supplies. No antidote exists for people who have been exposed.

"It's a heck of a lot easier to protect someone with a vaccine before a ricin exposure rather than to treat them with a drug afterward," Smith said. "Once ricin gets in the cells and has done the damage, it's going to be very, very difficult--if not impossible--to treat someone who has been exposed to a large dose. The damage has been done by the time one knows it. When somebody starts to have symptoms ... it may be impossible to save those people with any kind of therapy."

Ricin has had its fair share of the media spotlight in recent years. Press reports said the toxin turned up in an envelope in the mailroom that serves Senator Bill Frist's office and a postal handling facility in Greenville, S.C. It was also at the center of a plot in London where suspected al-Qaeda members were trying to make it.

Listed as a category B bioterrorism agent by the CDC, ricin is a threat to both service members and the public.

"It can be obtained quite readily as a byproduct of the castor beans," said Smith, who has worked for USAMRIID for 24 years. "After you extract what you need from the beans, like castor oil, there's quite a bit of ricin left behind. We have no medical solutions to defend against ricin intoxication and so we are vulnerable."

According to the CDC, ricin is also a very stable substance that's not affected much by hot or cold temperatures.

Because of ricin's sinister traits, researchers at the USAMRIID have been heartened by recent results they've had with their latest attempt at a vaccine candidate. Work on a ricin vaccine began in 1989, and the quality attributes of two vaccine candidates the institute developed early on didn't meet Food and Drug Administration (FDA) expectations. The third, a recombinant vaccine, capitalized on the lessons learned from the earlier attempts.

Ricin is composed of two protein subunits, the A chain and the B chain. When the B chain binds the toxin to a cell's surface, it permits the A chain to enter the cell. Once it's inside, the A chain stops new protein synthesis and causes cell death.

In earlier attempts to develop a ricin vaccine, researchers thought that isolating the entire ricin A chain could produce immunity. But

Castor beans are processed throughout the world to make castor oil. The poison Ricin is part of the waste "mash" produced when castor oil is made.

they found the chain wasn't stable, a key element for getting a vaccine approved for use.

By using molecular modeling and protein engineering, researchers -- including Drs. Mark Olson, John Carra, Virginia Roxas-Duncan, Robert Wannemacher, Smith and Charles Millard -- designed the new vaccine. The team started with a computer-aided analysis of the toxin structure, using a three-dimensional model provided by colleagues at the University of Texas, Austin.

"We compared ricin with other proteins of the same family," Olson said. "We tried to figure out where the protein molecules were diverging within the family-to see what changes were made by nature so we could make the changes we needed to make."

To improve the vaccine's stability, Olson and his team modeled changes in the structure of the ricin A chain molecule. Once they predicted which genetic sequences required alterations, they handed them off to Smith and others at USAMRIID for protein engineering.

"We went straight from the computer to molecular biology," Smith said. "We had to clone and purify the proteins, and test them in animals for toxicity and protection."

Four years later, the vaccine called RTA 1-33/ 44-198 is one the FDA should be pleased with, Smith said.

"Unlike earlier versions, this recombinant vaccine has no biological activity except for the immunity it elicits, which inactivates the toxin. It's produced and purified from *Escherichia coli* and is highly stable and safe," he said.

Researchers in July tested the vaccine on eight monkeys that received three shots of the vaccine over an eight-week period, then challenged them with an aerosol version of ricin. Final results of the study will be published in the scientific literature later this year, but in the meantime, Smith said he is pleased with the results. "The bottom line is the vaccine works," he said.

Getting the vaccine into a clinical trial is the next hurdle, Smith said. Currently, the USAMRIID vaccine is being considered for funding along with two other vaccines, said Andrea Atkinson, Vaccine Manager, Joint Project Manager, Chemical and Biological Medical Systems, Joint Vaccine Acquisition Program (JVAP). The organization manages biological defense vaccines through advanced development and FDA licensure.

"We are looking at schedule, who can be licensed fastest and which one meets our requirements," Atkinson said, adding that the JVAP has not yet picked the finalist for funding.

Once a funding stream opens for a vaccine like ricin, many pharmaceutical companies will want to put their canoe in the water. That's good news, Atkinson said.

"That's fantastic for the Soldiers because you know there will always be something available. There will always be a next-generation candidate out there," she said. "It's also risk reduction from our perspective. If we experienced a failure with a candidate, then there is something else coming down the pipeline to mitigate that risk."

Meanwhile, the USAMRIID team is developing an animal model that can be used under the FDA's Animal Rule to show the vaccine protects its recipients.

"You can't challenge humans so it was necessary to develop a surrogate model to show the human is protected by the vaccination, especially from these products that aren't normally found in the environment," Smith said.

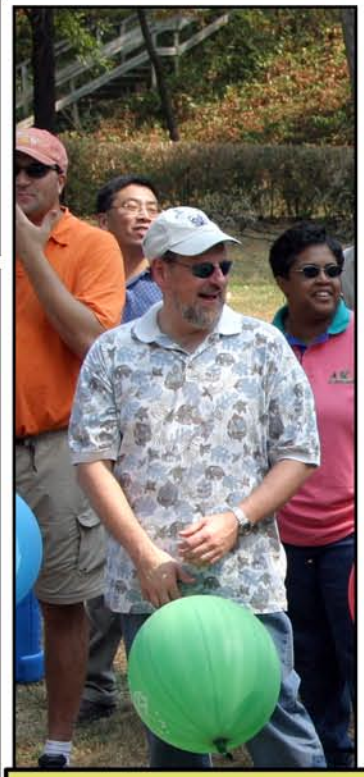
While funding decisions are being deliberated, Smith said he and his team remain busy in their Biosafety Level Two laboratory looking at other funding opportunities for clinical trials and laying the foundation for them. The Defense Threat Reduction Agency has approved funding for the continued technology base development of the vaccine for fiscal year 2006.

"We'll keep going. There's no question about that. My job is to ... try to partner with whoever we can to get resources to have a lot of vaccine made ... and get that clinical trial going," he said.

"Inhaling the toxin causes severe breathing problems as the lungs fill with fluids because the toxin attacks cells in the lung."

JPEO-CBD ~~Picnic~~ Organizational Day

The first Joint Program Executive Office for Chemical and Biological Defense Organization Day was designed as a day of camaraderie for staff personnel and family members. Fun games, good food and great activities mark the day.



Each person had a chance to relax and get to know balloon toss, three-legged race and Jeopardy, to

one another while participating in events such as dizzy-bat, name a few. The day fostered morale and team building.

JPM GUARDIAN Of The Year

By Stephen Gude, Assistant Editor, Chem-Bio Defense Magazine

The Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD) Joint Project Manager (JPM) Guardian, headed by Col. Camille Nichols, was recently awarded the Secretary of the Army Award for Project Management 2005. The award recognized Army programs and managers whose outstanding accomplishments and contributions merit special recognition. It was based on the success of the program and overall management of the program or project, according to the award guidelines. Nichols and JPM Guardian were recognized for the $1.8 billion program's rapid ascent.

When Nichols commissioned the project office two and a half years ago with her deputy, Donald Buley, the only thing that was at hand was a bunch of empty desks and a mandate to accomplish a mission. Now that Guardian is a worldwide bedrock of civil security and force protection, the mission is well on its way to being accomplished.

"I think even though the award says 'Program Manager of the Year,' it's really 'Program Manager Office of the Year,'" Nichols said. "It's an honor for me to even be considered, but I couldn't have done it without the support of my team and that of Brig. Gen. Stephen Reeves, the Joint Program Executive Officer for Chemical and Biological Defense."

Also, Guardian – which includes the Installation Protection Program (IPP), the Army Weapons of Mass Destruction-Civil Support Team (WMD-CST) and Force Protection Systems (FPS) – did not exist two and a half years ago.

"Understanding what we started with, when we were told our mission was 'protect our bases, now go accomplish the mission,' this achievement is absolutely staggering," Buley said. "We had a very limited understanding of what it takes to protect an installation, and look where we are now: we've figured out how to (protect bases) within the Department of Defense (DoD), but now were figuring out how to help protect the communities surrounding those bases. So our mission keeps expanding."

"Don and I started Guardian with two people and a bunch of empty desks," the colonel said. "To have an organization that didn't exist a couple of years ago, and then to perform at such a level that it is noticed in this way, says great things about the people who are dedicated professionals and motivated to accomplish the mission."

Today Guardian maintains a small staff of only 14 personell and the mission is distinct:

- The IPP assists DoD in preparing for, preventing, responding to and recovering from chemical, biological, radiological and nuclear events by providing effective and affordable capabilities.
- FPS provides affordable,

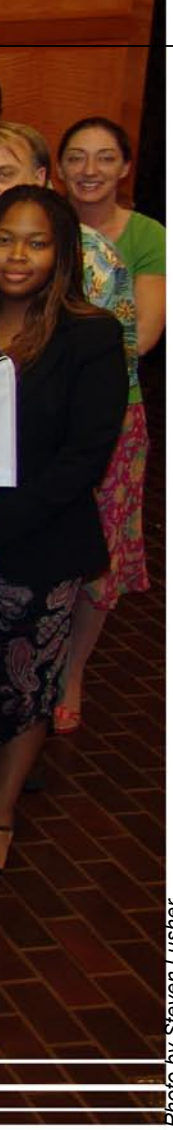


Photo by Steven Lusher

modular, scaleable and supportable tactical force protection capabilities to forward deployed forces while simultaneously providing state-of-the-art physical security equipment to DoD installations worldwide.

- WMD-CST provides CBRN analytical, communications, protection, response and survey capabilities in support of civil support teams and reserve reconnaissance and decontamination platoons in support of homeland security requirements.

Nichols, a tough, results-oriented leader, showed adoration for her team when she and her deputy spoke of the team's efforts.

"Everyone had to learn," Buley began. "Everyone had to work hard at how to do their jobs better. They all learned on their own and some of them got beat up a lot, but in doing so, they all became very smart and knowledgeable on what it took to work here."

"Some of them commute from a long way away," Nichols said. "They're experts in their fields and they believe they are contributing to the success of our fight against terrorism. They come in because they believe in what they're doing." With this belief, the team finds itself being molded as one, despite being in three different locations. Nichols lends considerable oversight to the program.

"I try to give enough guidance and direction for the program managers to do the job, but provide enough micromanagement – only when necessary – to get the mission accomplished," she said. "Doing the right thing is the easy part, because it's based on my morals. But learning what everyone needs – what decisions need to be made – that's the stuff that keeps me on my toes."

Still, her leadership abilities aren't innate, she said. They were learned throughout a career that includes assignments that varied from company commander to staff work in the Pentagon.

"Everything in my background prepared me for this job," Nichols said. "Not just my acquisition experience, but the leadership and personal lessons I learned as a company commander, as an engineering officer and when I was at the Pentagon. The skill set and professional and personal development from that helped me when it came time to build a team here, and the team we put together won the award."

That experience has also taught her to give guidance to her program managers, then allow them the freedom to run the programs. Her philosophy reflects that of Brig. Gen. Reeves; her hands are on the steering wheel, guiding, while her program managers are the engine, powering the team where it needs to be. As obstacles arise, Nichols steers.

"My goal, along with my program managers," she continued, "is crafting a business plan for each program. We're looking to grow the business. We want to be DoD's go-to guys regarding Force Protection and we're working toward that."

Nichols said her team believes in what it is doing, and that's what keeps them going. "We are integrating skill sets and commonalities with the three programs, but because they're in three locations, it's hard to make them feel they're part of a unified team. We're working to accomplish that through brown-bag lunch briefs, social events and other functions that bring us all together."

It is this type of unification that helped the team and Nichols earn the Secretary of the Army award. One plaque will always stay at Guardian, while the other will go with Nichols.

"It's like a final exam in a way," Nichols said, speaking of what she has personally taken from the experience. "All the years of working and being mentored and coached and becoming experienced in the field of acquisition. It's like when a brigade commander is graded on his unit during an evaluation. It took that commander a lot of years to be able to lead a unit into that position." For Nichols, earning the award doesn't mean she's going to rest on her laurels or be satisfied with where Guardian is. Perhaps "final exam" was a bit hasty…

"I'm still learning. I'll be learning this job until the day I depart," Nichols said.

Photo by Larry Wakefield

Col. Camille Nichols and Brig. Gen. Stephen Reeves at the formal award ceremony.

Photo by Larry Wakefield

L to R (front): Col. C. Nichols, Lt. Col. J. Smith. Second row: M. Moran, C. McClellan, W. Matthews, N. Topfer, F. Palmer, L. Strozier, and S. Speed. Third row: P. Rankin, C. Mundis, J. Matz, J. Mogan, G. Weaver, B. Spence, C. Bentley, B. Kunes, and J. Frank.

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‘The Reason for Our Success is Our People.’

Each month, the Joint Program Executive Officer, Brig. Gen. Reeves, recognizes those who reach the annual milestone of their birth. Those who shared in the celebration for the month of May are Elizabeth (Libby) Sass, James Ward, Bill Washington, Julius Evans and Jamila Lopez. Brig. Gen. Reeves also celebrates his birthday in May.

Subject Matter Experts Lt. Col. Janet Moser, Chemical Biological Medical Systems, Mr. Walt Dzula, Collective Protection and Mr. Jim Bryant, Information Systems, at the Air Force Association Conference, host the Joint Program Executive Office for Chemical and Biological Defense information booth.